DU BOIS-REYMOND A

A NEW SYSTEM OF AC MOTORS AND TRANSFORMERS BY NIKOLA TESLA*

In a lecture delivered on May 6th of this year before the American Institute of Electrical Engineers, Mr. Nikola Tesla reports on a new system of alternating current motors and transformers invented by him, essentially as follows:

In the usual transmission of work by direct current, alternating currents are always generated in the armature wires of the primary machine. These alternating currents must be combined into a direct current only when they enter the line and then decomposed back into individual current pulses when they enter the secondary machine. The basic idea of Tesla's system is to eliminate this double commutation. Imagine two direct current armatures, I and II, as shown in the figure. For this purpose, as Mr. Tesla demonstrates, each armature requires only two sections wound perpendicular to one another, and the ends of homologous sections a, a, with a, a, and b, b, with b_2, are connected by lines. If armature I is now allowed to rotate in a magnetic field, the current waves generated in its windings always simultaneously pass through homologous windings of the secondary armature II, generating a single magnetic axis in it that rotates at the same speed as the primary armature, while its intensity remains constant.

On this principle, Mr. Tesla based two types of motors, the "synchronous" and the "asynchronous." He places inside the secondary armature, which in this case, as in the figure, must have a ring shape, a diametrically opposed iron core A, mounted on the geometric axis of the ring, approximately in the shape of a double-T armature. This armature will naturally tend to assume the position in which it captures the most lines of force, i.e., it will seek to follow the rotating magnetic axis of the ring and, left to its own devices, will after some time begin to rotate synchronously with the primary armature. If this armature were wound provided with, which would be excited with direct current, such a motor would, as long as synchronism prevails, be the exact reverse of an ordinary direct current motor. If the winding of the double-T armature is short-circuited, then, according to Mr. Tesla, starting is facilitated because the currents that arise in this short-circuited winding, as long as synchronism has not yet been achieved, tend to delay the onset of the maximum magnetization in the double-T armature. As soon as synchronism is established, the armature winding naturally remains inert.

Mr. Tesla now uses this time shift of the maximum magnetization in the second type of his motor, whose power is intended to be independent of the ratio of the speeds of the primary and secondary machines: The double T armature is connected by a drum armature is replaced, whose coils are all short-circuited. If this armature is now braked such that its rotational speed is a constant amount lower than that of the magnetic axis of the secondary ring, the latter can be considered stationary, while the

armature rotates at the difference between the two speeds. It follows that current waves are induced in the closed coils of the inner, moving armature, which tend to shift the respective position of the induced magnetic axis of the inner moving armature by a constant angle opposite to the direction of rotation. Thus, the intensity of the interacting poles is not increased by the short-circuited coils, as one might be led to assume from Mr. Tesla's phrasing but the effective poles are given a position, at the expense of their intensity, in which their mutual attraction is able to produce a greater effect.

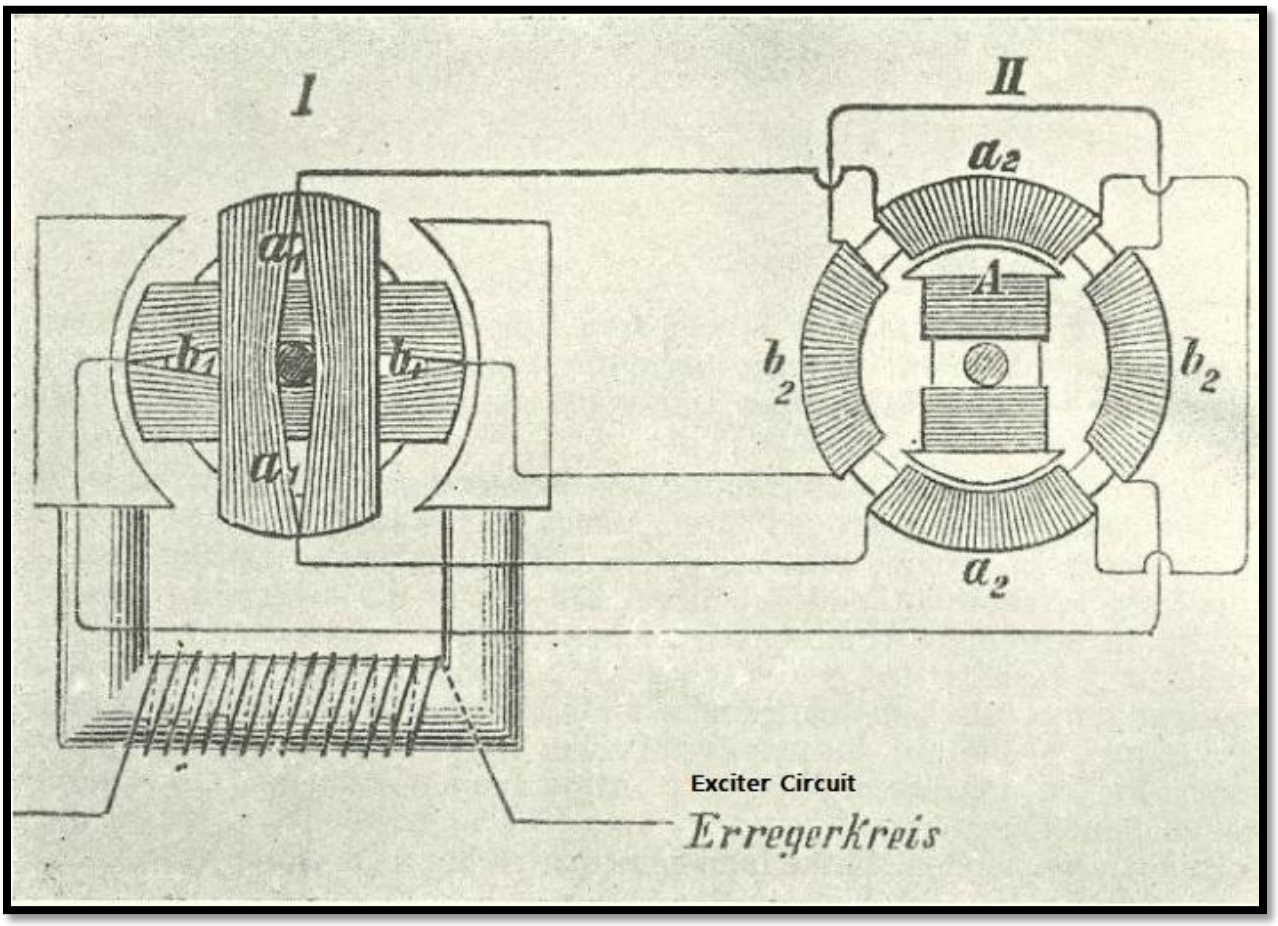

Fig. 1

Such a motor should behave exactly like a DC motor, deliver equally good efficiency under suitable load, and moreover possess the advantageous property that it can never exceed a certain, predetermined speed. Unfortunately, Mr. Tesla refrains from providing any numerical data regarding power, efficiency, and volt-ampere requirements; however, some things can be noted a priori. Apart from the fact that Mr. Tesla needs four primary leads, or, as he states, at least three, his motor differs from an ordinary DC motor in that, firstly, a constant loss of energy due to magnetization must occur in both the stationary and rotating parts, and secondly, the driving force is solely the attraction of an electromagnet to soft iron, instead of, as in a DC motor, the attraction of electromagnet to electromagnet.

Finally, as for the use of Tesla's rotating magnetic axis for the transformation of high-voltage currents, which he briefly discusses at the end of his lecture, his hopes for improved efficiency are likely to be thwarted by the fact that he is forced to work with free magnetism. Nevertheless, his invention must be considered extremely ingenious, and the future may tell whether this new system will be able to compete for survival against the established ones.

* ETZ, Berlin, 1888, p. 343